Heat, Health, and Asthma: Saving Lives Through Warning System Development

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How Are These Systems Unique?

- **A custom-made system is developed for each urban area, based on specific meteorology for each locale, as well as urban structure and demographics**

- **These systems are based on actual weather-health relationships, as determined by daily variations in human mortality**

- **These systems are based on much more than just temperature and humidity**

Steps in system development

- **Step 1:** Determine air masses daily over a city using newly-developed Spatial Synoptic Classification (SSC)

- **Step 2:** Are any of these air masses 'offensive'?

- **Step 3:** What aspects of the offensive air mass make it most detrimental to human health?

Air Masses Within the Spatial Synoptic Classification (SSC)

- **Moist Polar (MP)**
- **Moist Moderate (MM)**
- **Moist Tropical (MT)***
- **Dry Polar (DP)**
- **Dry Moderate (DM)**
- **Dry Tropical (DT)***
- **Transition**

***The moist tropical air mass will be subdivided to isolate the most oppressive cases**

TORONTO MEAN AIR MASS CHARACTERISTICS

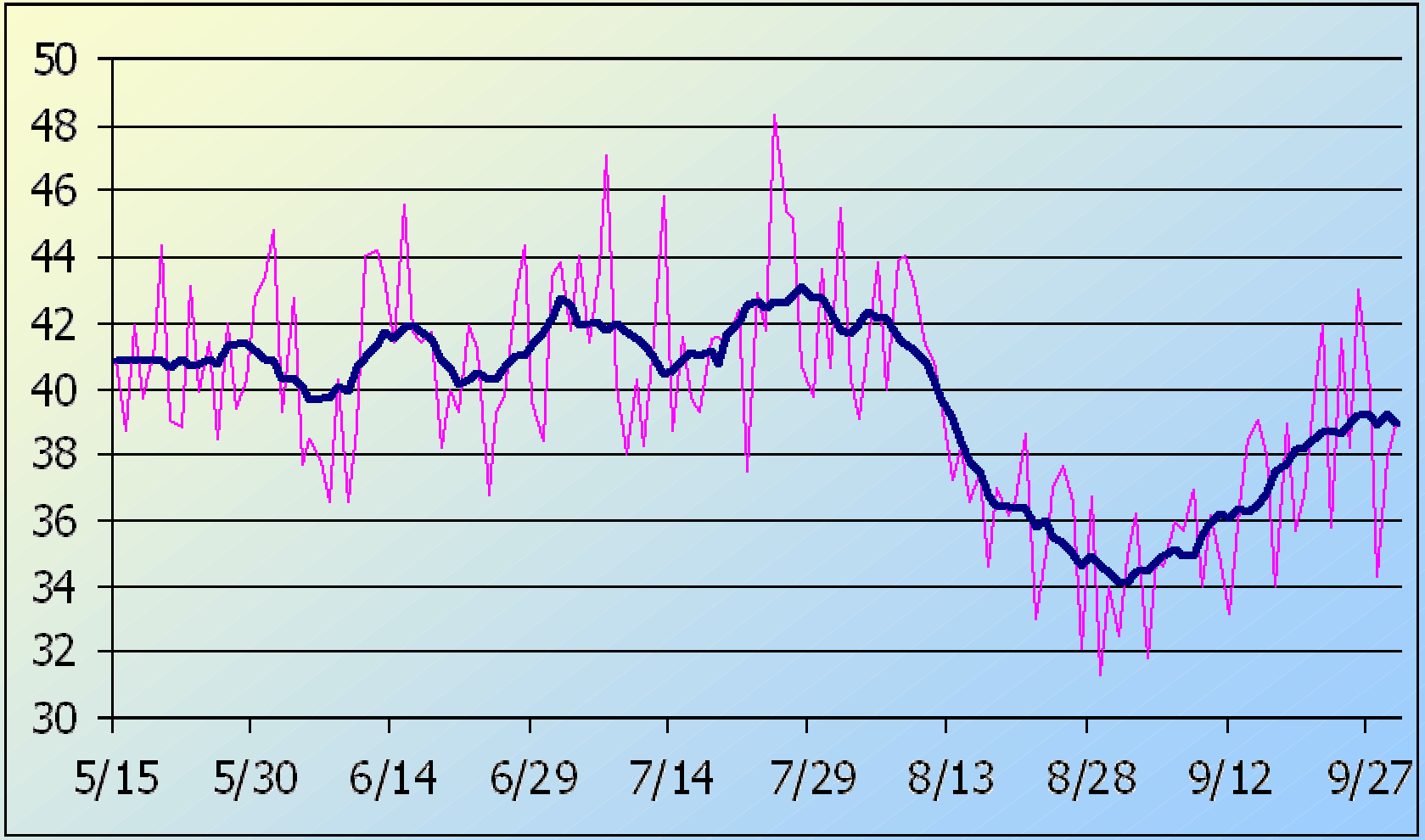
	Temp. 5 pm	Dew Pt. 5 pm	Temp. 5 am	Cloud Cover	Wind Direction	Wind Speed
DP	21.7	9.1	10.8	3.4	NW	13
DM	26.2	11.9	14.4	4.0	NW	12
DT	32.7	15.7	19.7	3.4	W	13
MP	17.9	12.7	13.8	7.6	NW	14
MM	22.8	17.3	17.6	7.6	S	11
MT	27.5	18.6	19.1	5.9	SW	12
MT+	30.3	20.6	22.3	4.7	SW	14
TR	24.3	14.5	16.9	5.7	Var	17

	Mean frequency of occurrence (% of days)					Excess
	May	**June**	**July**	**Aug.**	**Sept.**	**Mortality**
DP	25	23	13	13	15	39%
DM	23	20	34	35	29	45%
DT	5	4	4	1	< 1	63%
MP	13	10	4	4	12	45%
MM	14	16	17	20	18	44%
MT	6	15	15	15	9	55%
MT+	3	4	5	4	4	65%
TR	10	9	8	8	12	41%

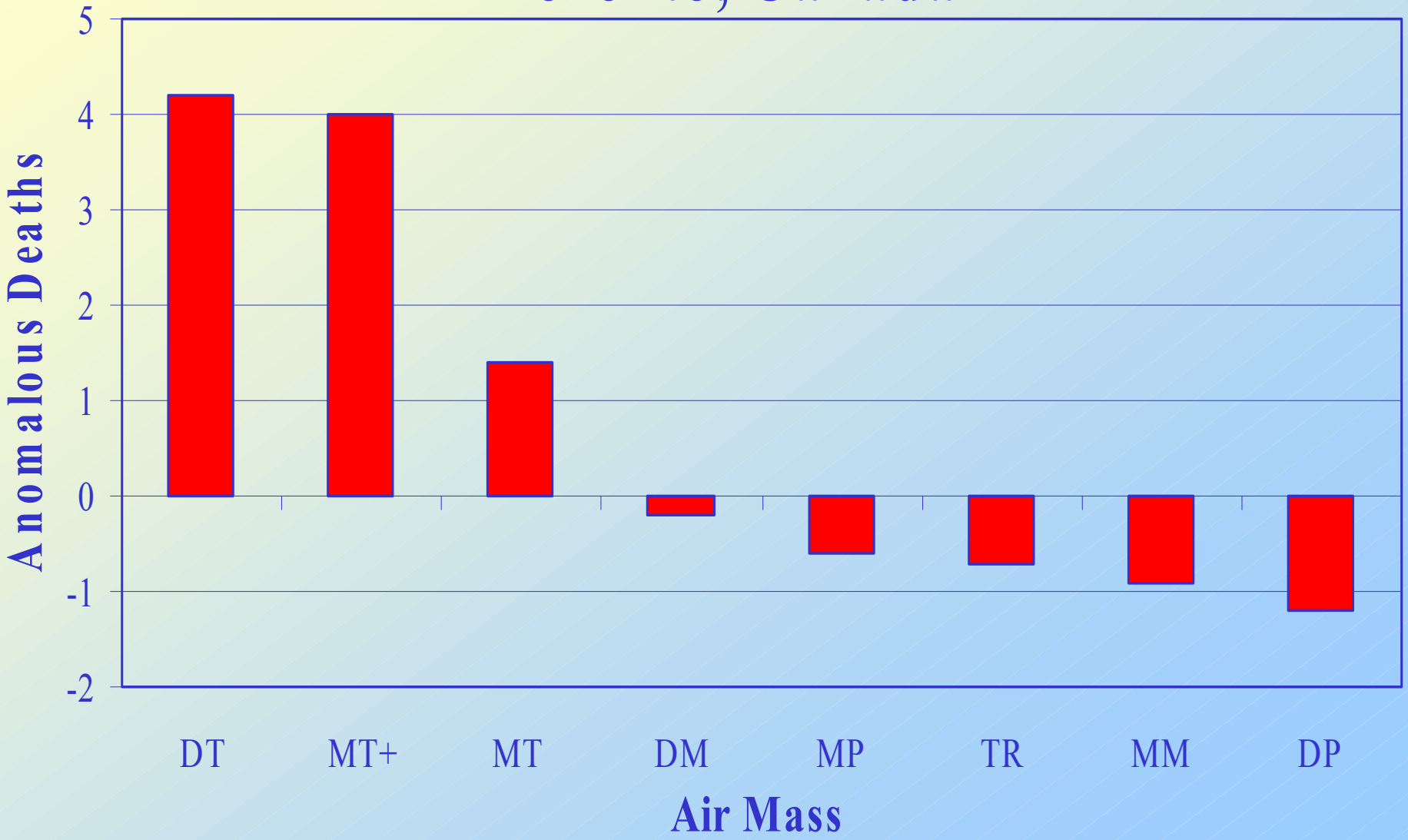
Removing Non-Climatological Noise from the Mortality Data

Mean deaths in Rome by day

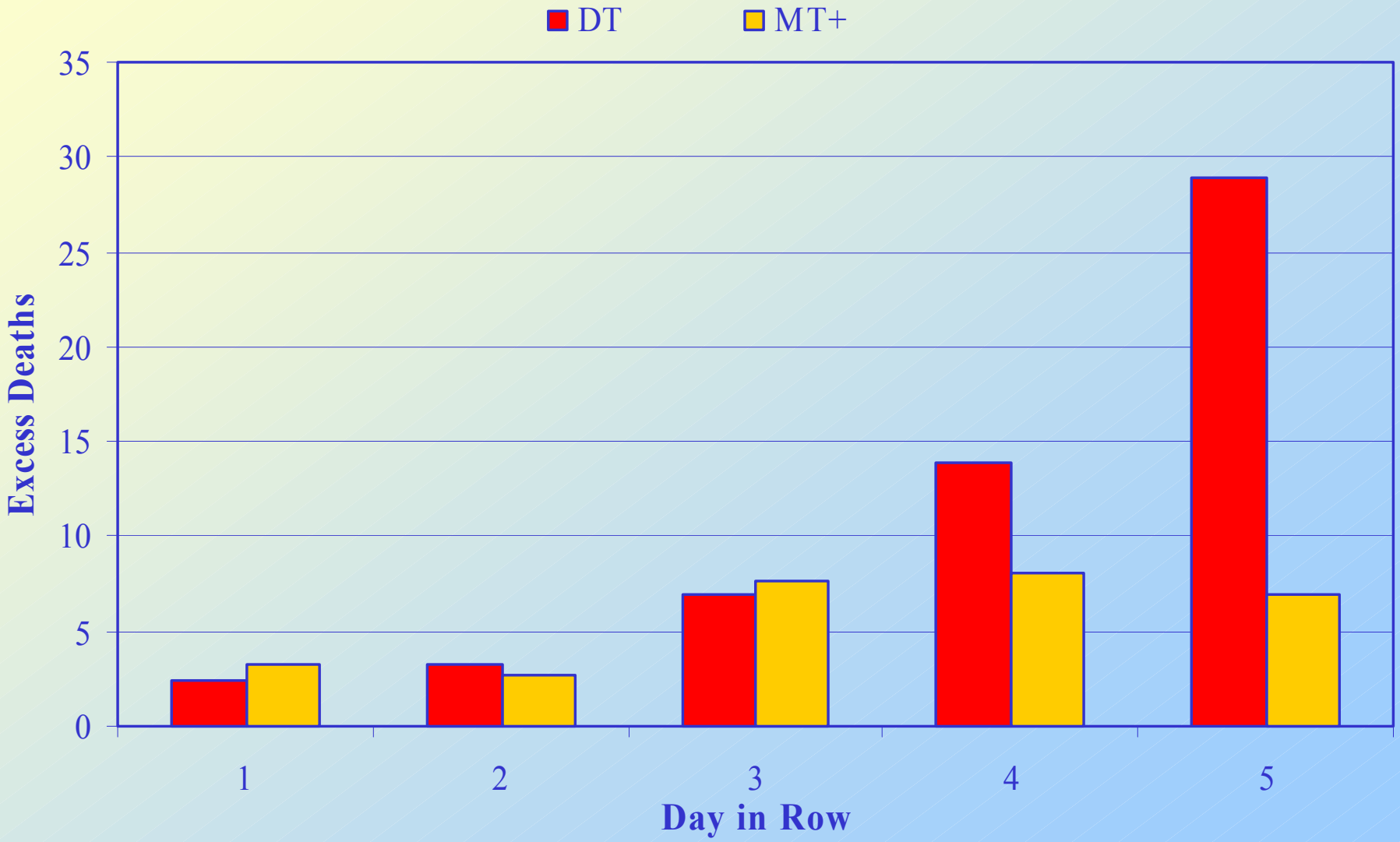
standardization is important



Mean Excess Deaths for Each Air Mass: Toronto, Canada



Excess Mortality for Offensive Air Masses: Impact of Days in a Row



When a DT or MT+ air mass is called, three levels of advisory are possible:

EMERGENCY
The likelihood of excess mortality exceeds 90 percent.
1.7 mean occurrences per year (0.9 DT, 0.8 MT+)

ALERT
The likelihood of excess mortality is between 65 and 90 percent.
6.3 mean occurrences per year (2.7 DT, 3.6 MT+)

ADVISORY
The likelihood of excess mortality does not exceed 50 percent.
3.4 mean occurrences per year (2.0 DT, 1.4 MT+)

TORONTO HEAT HEALTH ALERT SYSTEM

Afternoon Forecast
Issued 8/7/2001 15:13:49
Forecast for 8/8 - 8/9/2001

8/8: HEAT EMERGENCY
Conditions oppressive - with a 97% chance of excess mortality

8/9: HEAT EMERGENCY
Conditions oppressive - with a 92% chance of excess mortality

DAY				08/08				08/09
HOUR	05	11	17	23	05	11	17	23
TEMPERATURE	23	31	35	29	25	29	31	25
DEW POINT	22	22	23	23	22	23	23	22
CLOUDINESS				4				5
AIR MASS				MT+				MT+
DAY IN ROW				3				4

Forecast data provided by Meteorological Service of Canada - Ontario Region
Click here for the latest 5-day Public Forecast and latest observation at Pearson Airport

SYSTEM LEVELS

HEAT EMERGENCY

The likelihood of weather-related excess mortality occurring exceeds 90 percent.

HEAT ALERT

The likelihood of weather-related excess mortality occurring exceeds 65 percent.

ROUTINE MONITORING

An oppressive air mass is forecast, although conditions do not suggest excess mortality is likely.

PHOENIX HEAT WATCH WARNING SYSTEM

Afternoon Forecast
05/10/01 13:55:03
Forecast for 5/10 - 5/11/2001

5/10: HEAT ADVISORY

5/11: NO ADVISORY

DAY				05/10				05/11
HOUR	02	08	14	20	02	08	14	20
TEMPERATURE	83	82	102	95	82	81	101	102
DEW POINT	38	39	39	37	41	40	40	39
CLOUDINESS				0				0
AIR MASS				D1				DT
DAY IN ROW				0				0

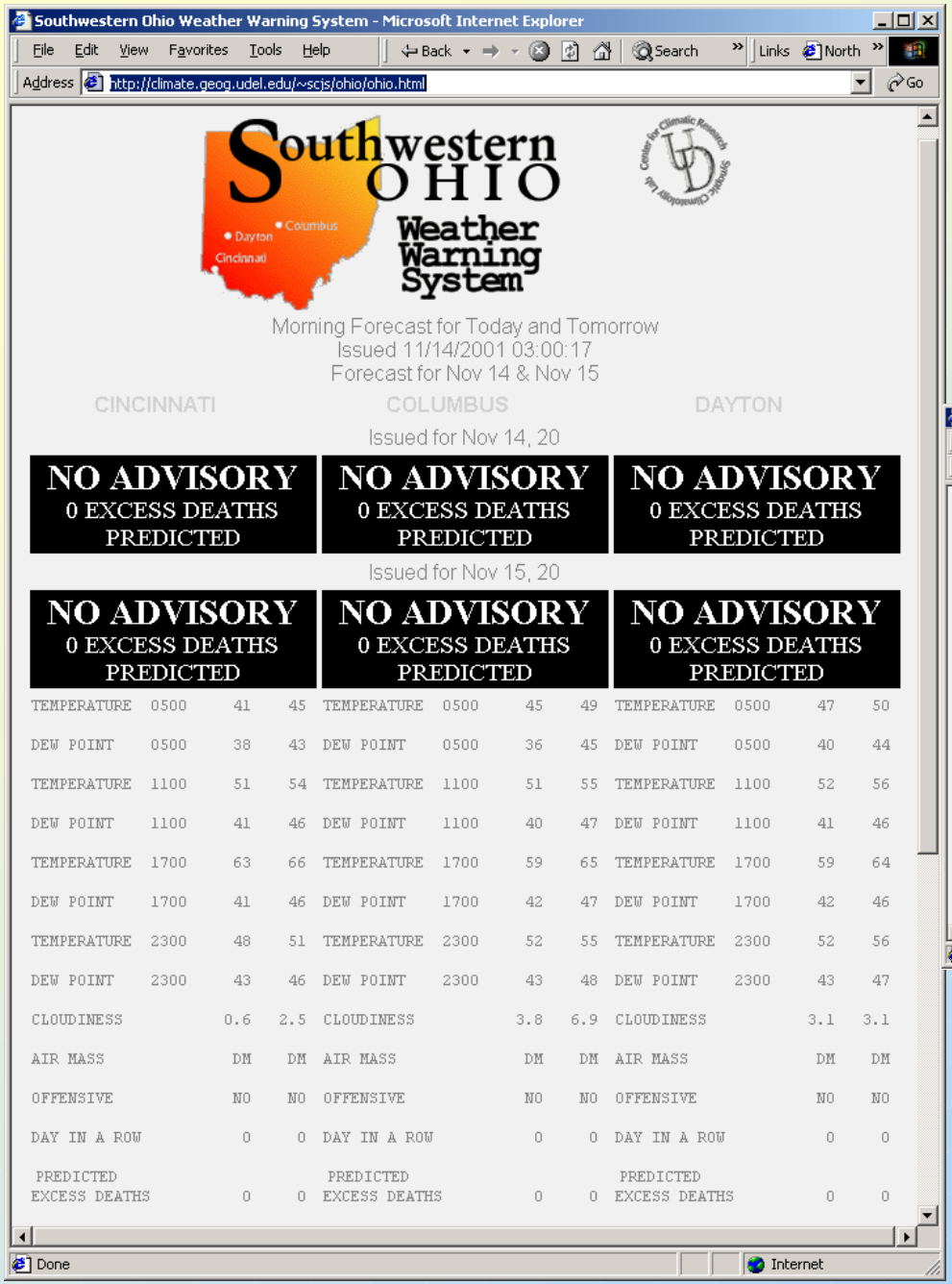
SYSTEM LEVELS

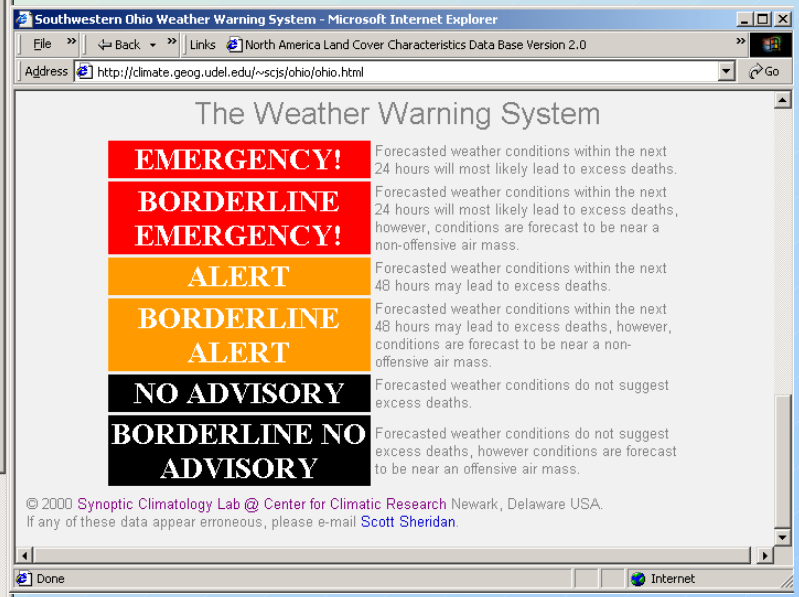
HEAT WARNING
Similar weather conditions in the past have been associated with excess deaths.

HEAT ALERT
Weather conditions are between advisory and warning levels.

HEAT ADVISORY
Weather conditions may lead to weather-related excess mortality.

NO ADVISORY
Weather conditions are not forecast to be oppressive.


Southwestern Ohio Weather Warning System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Links North
Address http://climate.geog.udel.edu/~scjs/ohio/ohio.html
Go
Southwestern OHIO
Dayton
Columbus
Cincinnati
Weather Warning System
Center for Climatic Research
Synoptic Climatology Lab
Morning Forecast for Today and Tomorrow
Issued 11/14/2001 03:00:17
Forecast for Nov 14 & Nov 15
CINCINNATI
COLUMBUS
DAYTON
Issued for Nov 14, 20
NO ADVISORY
0 EXCESS DEATHS
PREDICTED
NO ADVISORY
0 EXCESS DEATHS
PREDICTED
NO ADVISORY
0 EXCESS DEATHS
PREDICTED
Issued for Nov 15, 20
NO ADVISORY
0 EXCESS DEATHS
PREDICTED
NO ADVISORY
0 EXCESS DEATHS
PREDICTED
NO ADVISORY
0 EXCESS DEATHS
PREDICTED
TEMPERATURE 0500 41 45
DEW POINT 0500 38 43
TEMPERATURE 1100 51 54
DEW POINT 1100 41 46
TEMPERATURE 1700 63 66
DEW POINT 1700 41 46
TEMPERATURE 2300 48 51
DEW POINT 2300 43 46
CLOUDINESS 0.6 2.5
AIR MASS DM DM
OFFENSIVE NO NO
DAY IN A ROW 0 0
PREDICTED EXCESS DEATHS 0 0
TEMPERATURE 0500 45 49
DEW POINT 0500 36 45
TEMPERATURE 1100 51 55
DEW POINT 1100 40 47
TEMPERATURE 1700 59 65
DEW POINT 1700 42 47
TEMPERATURE 2300 52 55
DEW POINT 2300 43 48
CLOUDINESS 3.8 6.9
AIR MASS DM DM
OFFENSIVE NO NO
DAY IN A ROW 0 0
PREDICTED EXCESS DEATHS 0 0
TEMPERATURE 0500 47 50
DEW POINT 0500 40 44
TEMPERATURE 1100 52 56
DEW POINT 1100 41 46
TEMPERATURE 1700 59 64
DEW POINT 1700 42 46
TEMPERATURE 2300 52 56
DEW POINT 2300 43 47
CLOUDINESS 3.1 3.1
AIR MASS DM DM
OFFENSIVE NO NO
DAY IN A ROW 0 0
PREDICTED EXCESS DEATHS 0 0
Done
Internet


Southwestern Ohio Weather Warning System - Microsoft Internet Explorer
File Back Links North America Land Cover Characteristics Data Base Version 2.0
Address http://climate.geog.udel.edu/~scjs/ohio/ohio.html
Go
The Weather Warning System
EMERGENCY!
Forecasted weather conditions within the next 24 hours will most likely lead to excess deaths.
BORDERLINE EMERGENCY!
Forecasted weather conditions within the next 24 hours will most likely lead to excess deaths, however, conditions are forecast to be near a non-offensive air mass.
ALERT
Forecasted weather conditions within the next 48 hours may lead to excess deaths.
BORDERLINE ALERT
Forecasted weather conditions within the next 48 hours may lead to excess deaths, however, conditions are forecast to be near a non-offensive air mass.
NO ADVISORY
Forecasted weather conditions do not suggest excess deaths.
BORDERLINE NO ADVISORY
Forecasted weather conditions do not suggest excess deaths, however conditions are forecast to be near an offensive air mass.
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If any of these data appear erroneous, please e-mail Scott Sheridan.
Done
Internet

Summary of Watches/Warnings under NWS System and Air Mass System, Summer 2001
New Orleans, Louisiana

May 2001

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

June 2001

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

September 2001

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
30						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

July 2001

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

August 2001

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

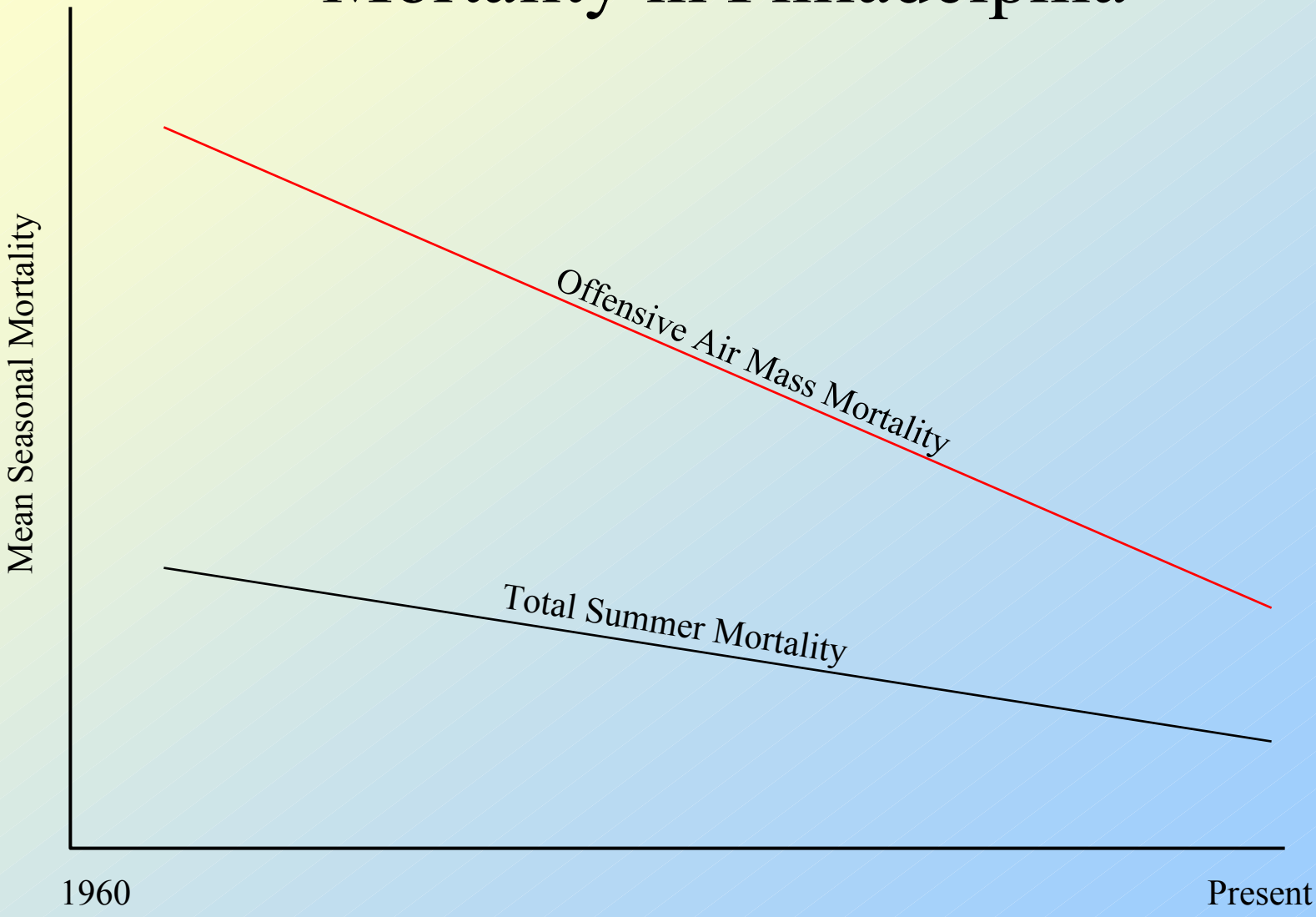
NWS warning under old system
(Max AT > 105° F, min AT > 80° F)

System called watch

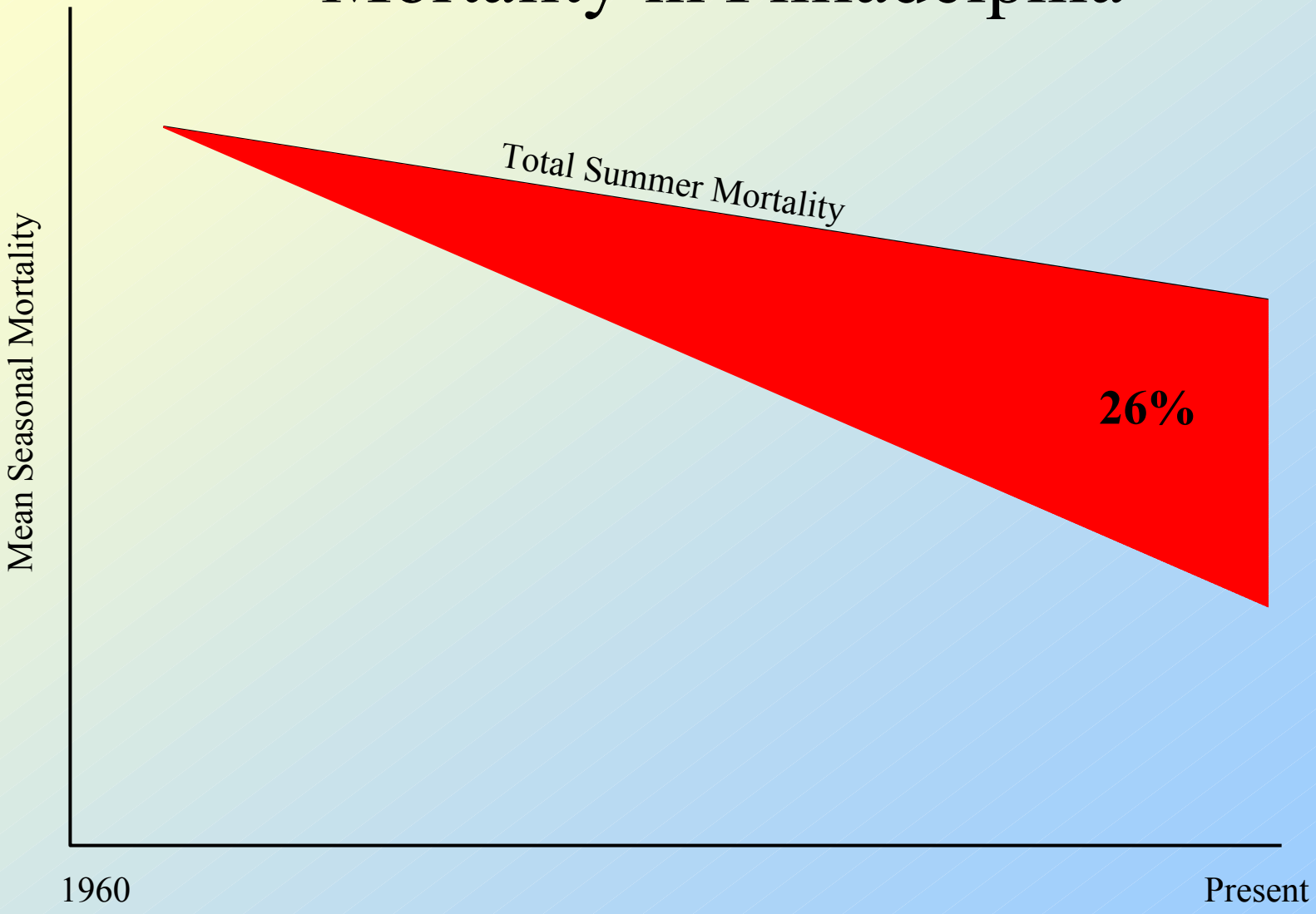
An Important Issue

Has air conditioning improved the mortality situation, or has it made things worse?

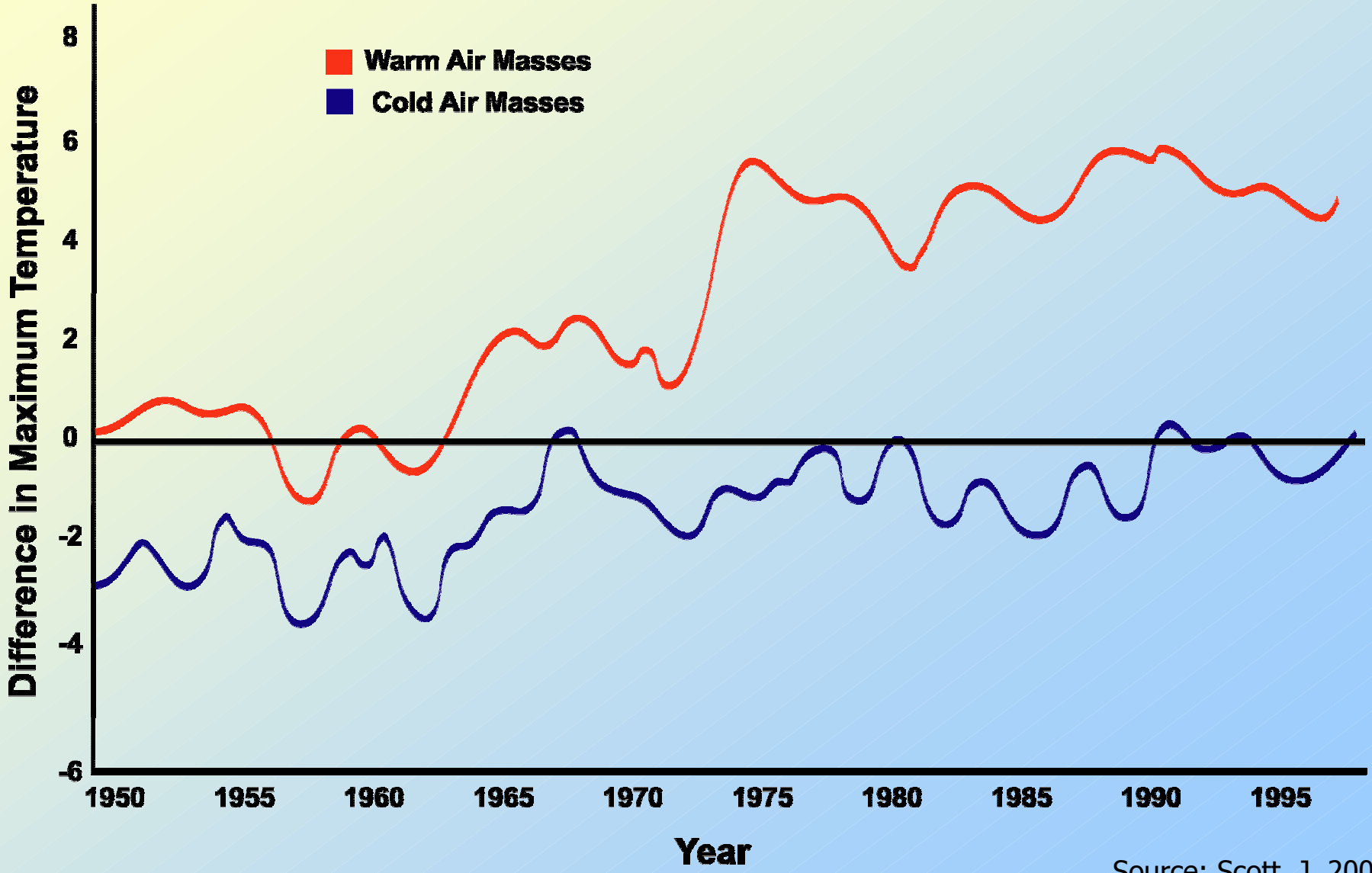
Air Conditioning and Mortality in Philadelphia



Air Conditioning and Mortality in Philadelphia



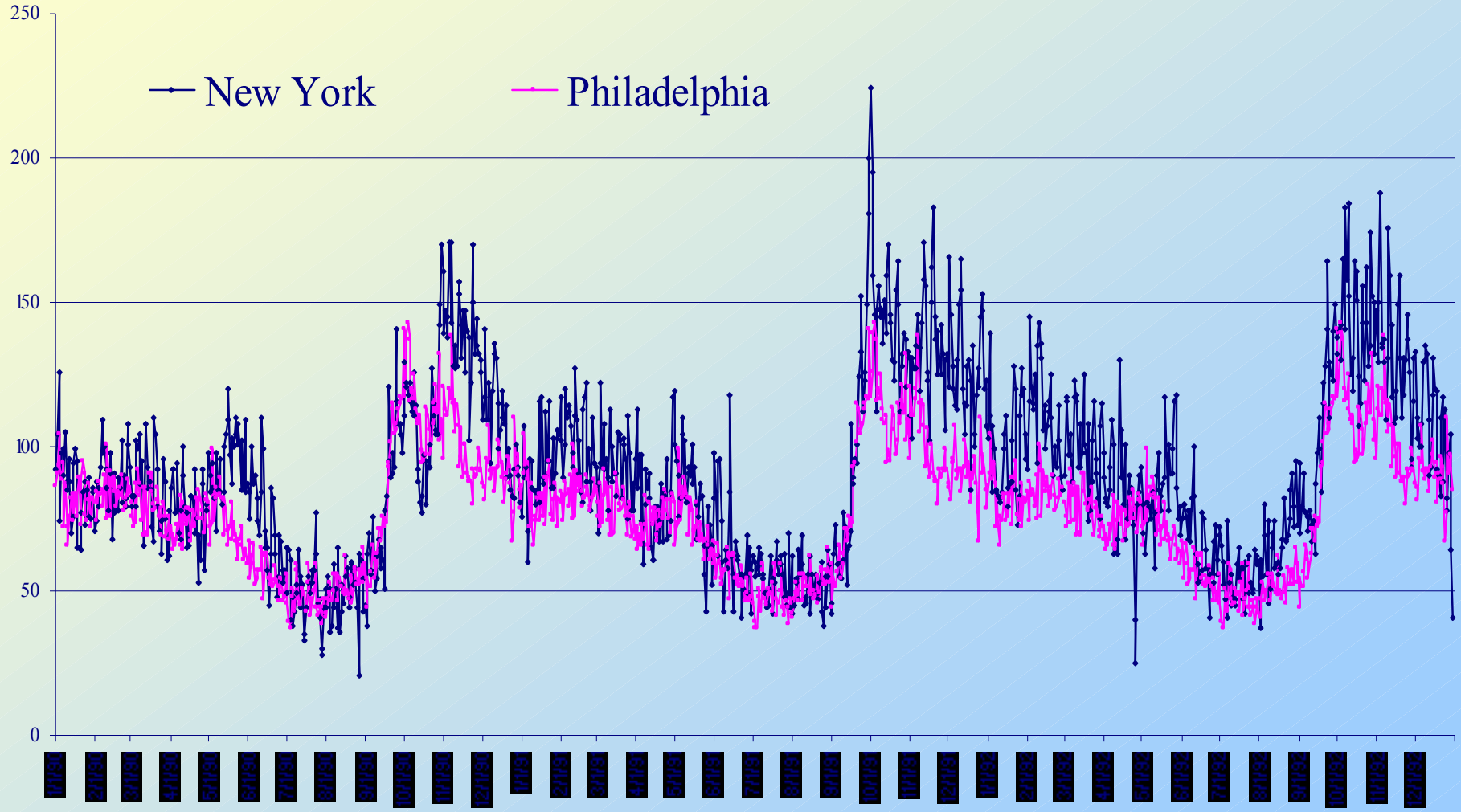
St. Louis Airport vs. Jerseyville
1950 to 1999



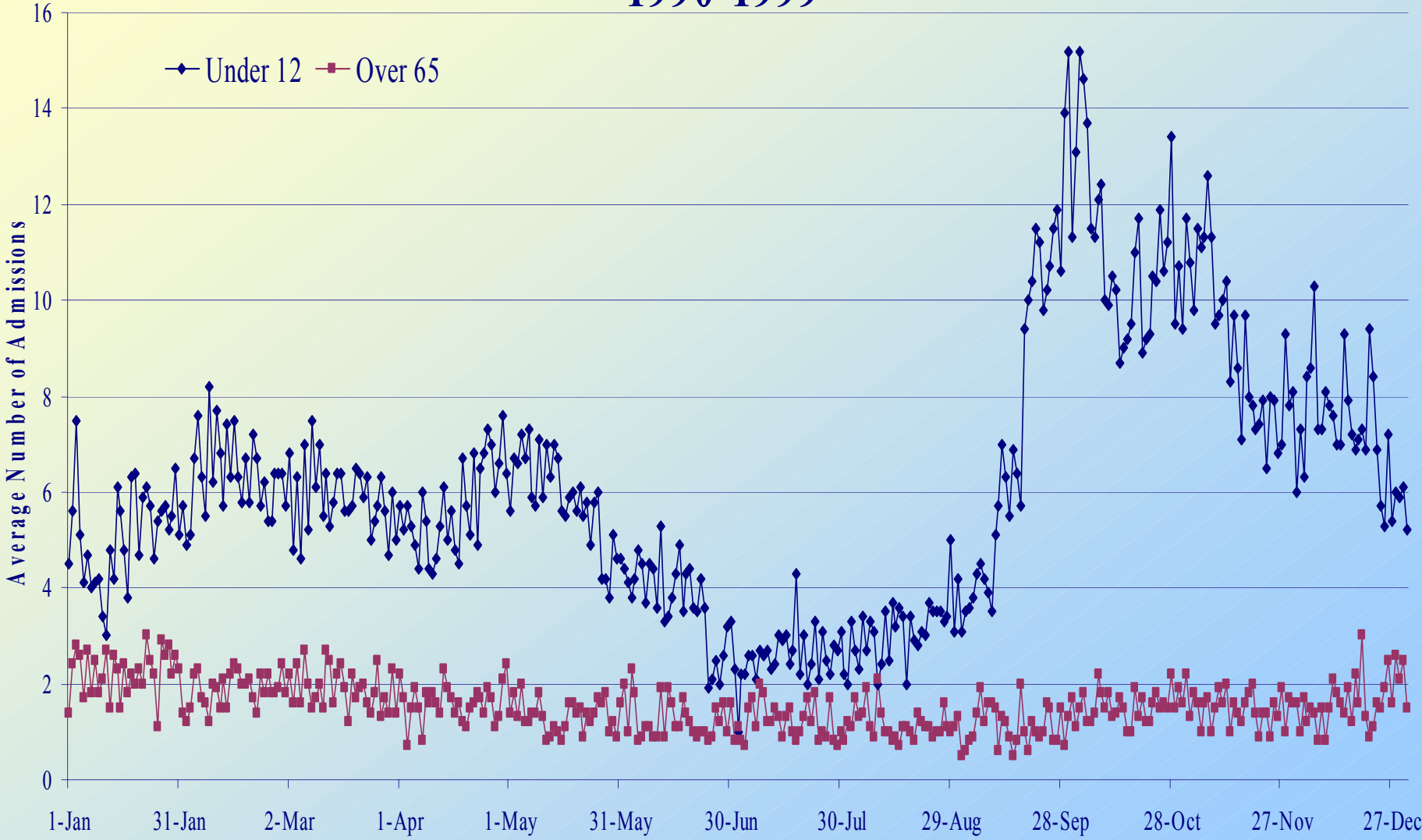
Source: Scott, J. 2001.

Can we create a similar system for asthma hospital admissions?

Asthma Admissions
1 Jan 1990 to 31 Dec 1992



Philadelphia Asthma Admissions
1990-1999



Holiday Asthma Admissions

Winter Daily Asthma Admissions

Summer air mass thresholds . . .

- Criteria
  - DT or MT+ air mass
  - Weekends, AM temperature greater than 27 °C and dew point greater than 21°C
  - Monday, AM temperature greater than 24°C and dew point greater than 20°C
  - Other weekdays, AM temperature greater than 25°C and dew point greater than 21°C
  - not more than .33 inches of precipitation
  - no warning if PM dew point less than 20°C and greater than 4°C dew point change

Preliminary Summer Decision Tree